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Claims

[c1] 1. A method for processing a rotor forging, the method comprising the steps of:

casting an ingot to have at least first and second ingot regions axially aligned within the ingot, the first and second ingot regions being formed of different alloys that intermix during casting to define a transition zone between the first and second ingot regions, the transition zone having a composition that differs from and varies between the first and second ingot regions;

forging the ingot to produce a rotor forging containing first and second forging regions and a transition zone therebetween corresponding to the first and second ingot regions and the transition zone of the ingot such that the first and second forging regions are formed of the different alloys and the transition zone of the rotor forging has a composition that differs from and varies between the first and second forging regions, the first and second forging regions and the transition zone therebetween being axially aligned along a geometric centerline of the rotor forging;

ascertaining boundary points of the transition zone within the rotor forging to define a plurality of two-

dimensional cross-sectional shapes of the transition zone; and then

using the plurality of two-dimensional cross-sectional shapes to produce a three-dimensional approximation of the shape of the transition zone within the rotor forging.

[c2] 2. The method according to claim 1, wherein the transition zone of the rotor forging is asymmetrical about the geometric centerline of the rotor forging following the forging step.

[c3] 3. The method according to claim 1, further comprising the steps of:

producing a rotor forging specimen in accordance with the casting and forging steps of claim 1, whereby the rotor forging specimen contains first and second specimen regions and a transition zone therebetween, the first and second specimen regions are formed of the different alloys, the transition zone of the rotor forging specimen has a composition that differs from and varies between the first and second specimen regions, and the first and second specimen regions and the transition zone therebetween are axially aligned along a geometric centerline of the rotor forging specimen;

ascertaining boundary points of the transition zone within the rotor forging specimen to define a plurality of two-dimensional cross-sectional shapes of the transition

zone within the rotor forging specimen;

using the plurality of two-dimensional cross-sectional shapes of the transition zone within the rotor forging specimen to produce a three-dimensional approximation of the shape of the transition zone within the rotor forging specimen; and

using the three-dimensional approximation of the shape of the transition zone within the rotor forging specimen and the boundary points of the transition zone within the rotor forging to produce the three-dimensional approximation of the shape of the transition zone within the rotor forging.

[c4] 4. The method according to claim 3, wherein the step of ascertaining the boundary points of the transition zone within the rotor forging comprises determining at an outside surface of the rotor forging the level of at least one alloying constituent of at least one of the different alloys of the first and second specimen regions.

[c5] 5. The method according to claim 4, wherein the step of ascertaining the boundary points of the transition zone within the rotor forging specimen comprises:

sectioning the transition zone of the rotor forging specimen to define a sectioned surface on the rotor forging specimen; and then

performing chemical analysis on the sectioned surface to

determine levels of the alloying constituent at multiple locations on the sectioned surface.

[c6] 6. The method according to claim 3, wherein the step of ascertaining the boundary points of the transition zone within the rotor forging specimen comprises:
sectioning the transition zone of the rotor forging specimen to define a sectioned surface on the rotor forging specimen; and then
performing chemical analysis at multiple locations on the sectioned surface to determine levels of at least one alloying constituent of at least one of the different alloys of the first and second specimen regions.

[c7] 7. The method according to claim 1, further comprising the step of using the three-dimensional approximation of the shape of the transition zone within the rotor forging to predict centerline deflection of a rotor machined from the rotor forging.

[c8] 8. The method according to claim 1, further comprising the step of using the three-dimensional approximation of the shape of the transition zone within the rotor forging to identify an axial line through the rotor forging that is more centrally located with respect to material properties of the rotor forging than the geometric centerline of the rotor forging.

[c9] 9. The method according to claim 1, wherein the step of ascertaining the boundary points of the transition zone within the rotor forging comprises ultrasonically examining the rotor forging to produce a noise pattern corresponding to variations in metallurgical characteristics within the rotor forging attributable to changes in chemistry between the transition zone and the first and second rotor regions.

[c10] 10. The method according to claim 1, wherein the first rotor region is formed from an alloy chosen from the group consisting of CrMoV low alloy steels, martensitic stainless steels containing about 9 to about 14 weight percent chromium, Fe-Ni alloys, and nickel-base alloys, and the second rotor region is formed from an alloy chosen from the group consisting of NiCrMoV low alloy steels and martensitic stainless steels containing about 11 to about 14 weight percent chromium.